



Bias Adjustment for AIRS

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Why Adjust?

- We have measured radiances from the satellite
- We have calculated radiances from a known state
- Measured and calculated radiances are compared to get
 - The change from the known atmospheric state
- For a given state, measured and calculated must agree
- If not, then retrievals have systematic errors
- Modelers agree
 - Bias adjustment is needed
 - It should obviously be theirs
 - What's the problem



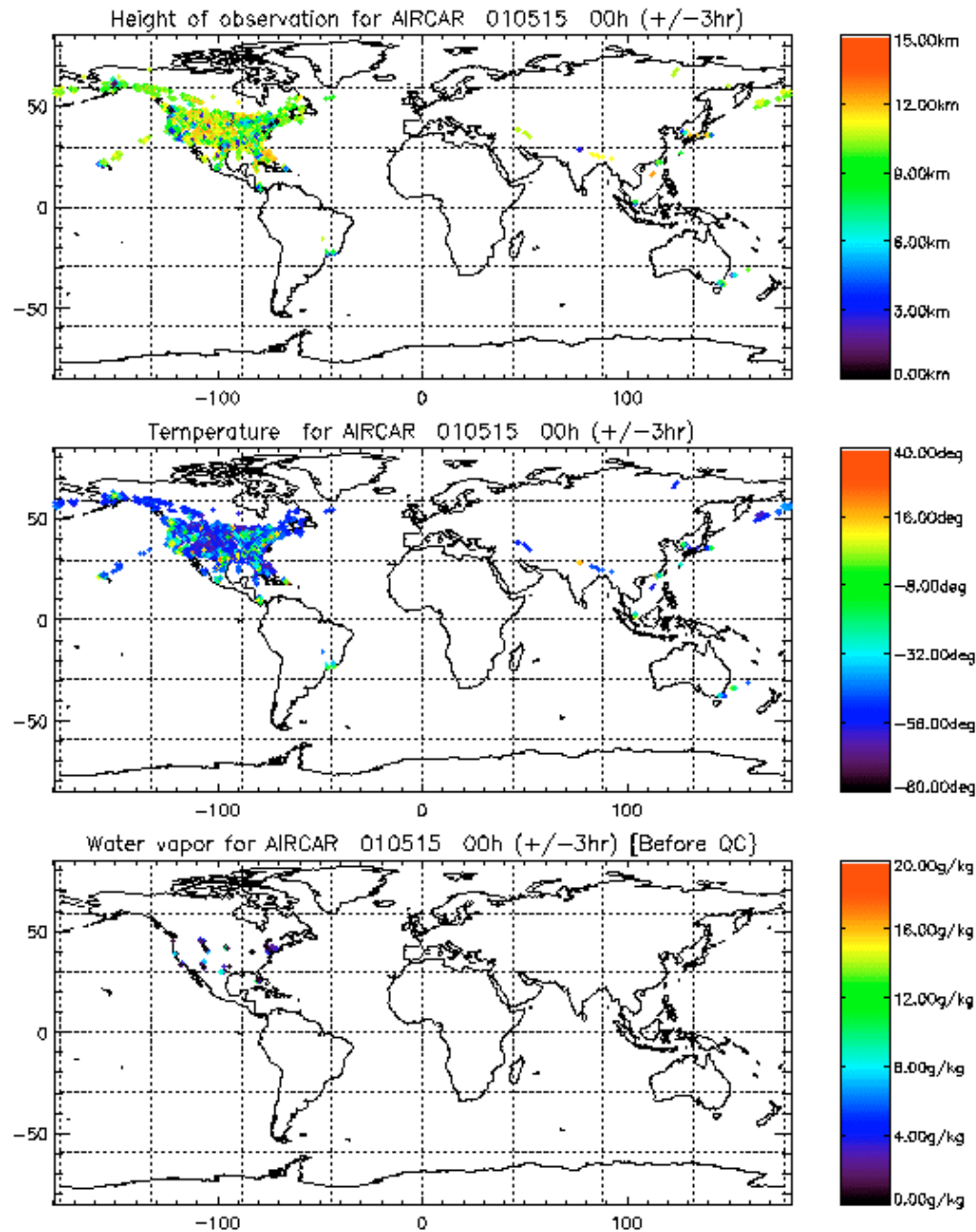
Steps For the Adjustment

- Select the “truth”
- Select the correction model
- Collect Pairs of Observations “matches”
- Generate adjustment coefficients
- Apply the coefficients



Choices for Truth

- Radiosondes
 - Differences in observations times
 - Radiosondes are limited to the lower atmosphere
 - Moisture measurements are not accurate in dry/cold conditions
- Models
 - Good for early evaluations
 - Good for bias errors and removing space/time differences
 - Models can have errors
 - Models have an internal tuning
- ARM
 - Sample size small
- AIRCRAFT
 - Provide observations at single points
- LIDAR
 - Not readily available





Choices for Truth - continued

- AIRS
 - What is better for upper level moisture?
- Other choices



What is truth?

- Truth is biased
 - Radiosondes measure the temperature of a sensor, not the air
 - Radiation corrections
 - Different types of radiosondes
 - Adjust radiosondes to a common type
- Use GPS to adjust moisture



Requirements

- Need a complete Specification of the profile
 - Surface skin temperature
 - Satellite
 - Buoys
- Upper atmospheric levels
 - Rocketsondes
 - Limb sounders
 - AIRS
- Water vapor
 - Radiosondes – GPS
- Other Gases
 - Ozone
- Use retrieval for missing information



Sampling Concerns

- Scan Angle Dependence
 - Single site observations - 1 observation - 1 scan angle
 - Spot-to-spot differences
 - Angle dependent biases
- Model
 - Truth for each observation
- Combined
 - Use model to remove spot to spot differences



Adjustment Philosophy

- Reason
 - Make satellite data compatible with some independent measure of the atmospheric state
- Concerns
 - May be adding fiction to good data
- Philosophy
 - Calculate the adjustment
 - Save it
 - Apply it as needed
 - Retrieval step
- Measured radiances are preserved
- Have a provision to redo the retrievals without the adjustment
 - Need to store 2 retrievals on the match file



Bias Adjustment or More

- Remove the mean error
 - Just one component of a systematic error
- Remove systematic differences by regression
 - Predict the adjustment, not the channel value
 - If all coefficients are small, the channel is itself plus a small change
 - Shrink to the initial state
 - Eigen vector regression
 - Add to the diagonal of predictor covariance
 - Note the normal initial state is that all coefficients are zero
 - But one can use the previous coefficients



Adjustment Model

- Predictors
 - Brightness temperatures
 - But not solar contaminated channels in daylight
 - Cosine latitude
 - Solar zenith angle
 - Scan angle
- Approach
 - Use model to remove scan position bias
 - Use model to angle adjust measurements to other bins
 - Use radiosondes for final adjustment



Performance

- Better than 0.5 K for good channels based on HIRS
- Simulations
 - Doing the most realistic case now
- Improvements
 - Short wavelength channels are hard to adjust in daylight
 - Use nighttime corrections
 - Apply to daytime data to adjust the emission component
 - Delete solar channels as predictors in daylight
 - This is not a problem because
 - To use short wavelength channels in daylight
 - Need to be able to calculate the solar component
 - Include reflection, scattering, and cloud shadows
 - Can the solar effects be accurately modeled?



Plans

- Generate adjustment coefficients for the new simulated cases
- Check the adjustments on new cases
- Refine the model
 - Minimize the adjacent spot problems
 - Short wavelength in daylight
- Add storage for unadjusted retrievals in the matchup file
- Use validation system to start tuning with HIRS



Switch Topics

- Preparing OPTRAN coefficients for AIRS
- Have kCARTA running and verified
- Dry gas fit to kCARTA is shown on the next slide

